

# REALITY

REALITY: Reliable and Variability tolerant System-on-a-chip Design in More-Moore Technologies

## Project Workshop

Core Level to System Level Flow Integration and  
Benchmarking

ST / UniBO Contribution



# Porting to Validation Benchmarks

- Policy for multimedia applications:
  - Variability-aware LP+BP V1.0: offline or approximated online (LUT)
  - Variability-aware LP+BP V2.0: the exact solution can be computed at runtime (in linear time)
    - Applicable to multimedia workload on a frame-by-frame basis
    - Assumes independent barrier-synchronized tasks
  - Tuning on the real platform and benchmarks:
    - Customization of the policy to the target case study

# MPEG2 decoder (from WP6)

- An implementation of an MPEG2 decoder has been provided to UniBO
- This version has been modified so that:
  - There is 1 control thread + N decode threads
  - The control thread will be mapped on the GPE and the decode threads will be mapped on the hardware threads of the xPEs
  - Each decoding thread decodes an N-th of the frame slices and one vertical portion of the frame image
  - N has been generalized to be whatever number greater than 0 (the upper limit is the number of slices and the number of horizontal macroblocks in each frame)

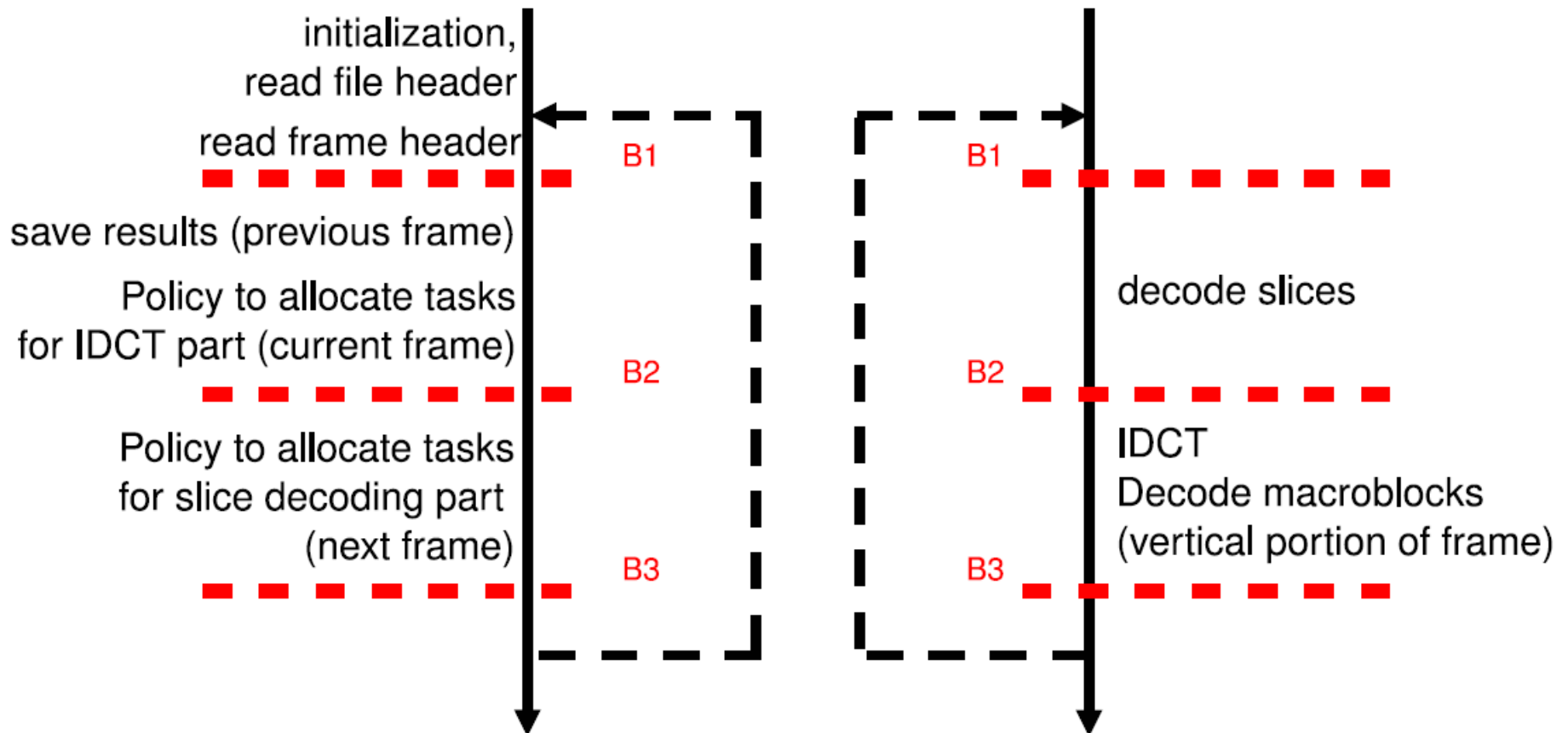


# Policy applied on MPEG2

## MPEG2 Execution Model

host core

xPE



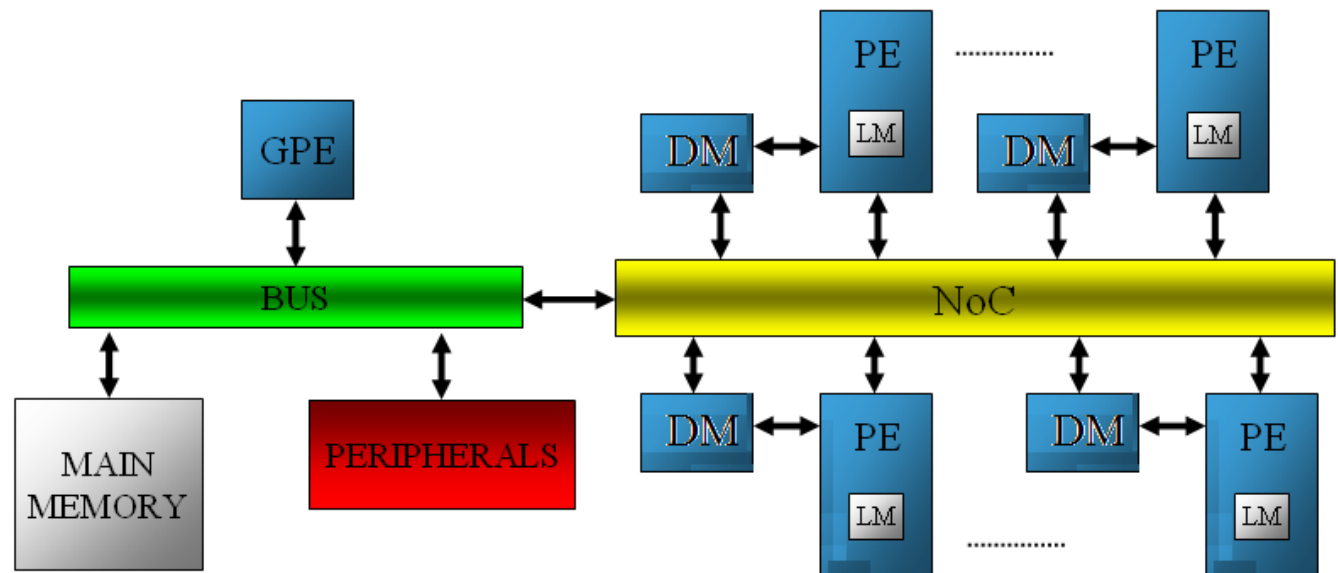
# Video profiling

Running a video decoding onto the nominal platform:

- Set intra-frame deadlines
  - Needed time to execute the *search slice* control part. We stored the time for each kind of frame (*intra picture, I; predicted picture, P; bidirectional picture, B*)
- Find cycles tasks (activity +stall)
  - For the *slice decoding* and the *IDCT*, we stored the **activity cycles** needed for each task of each frame (task-number dependent)
  - For the *slice decoding* and the *IDCT*, we calculated the maximum **stall cycles** ratio to adjust task cycles (core-number dependent)

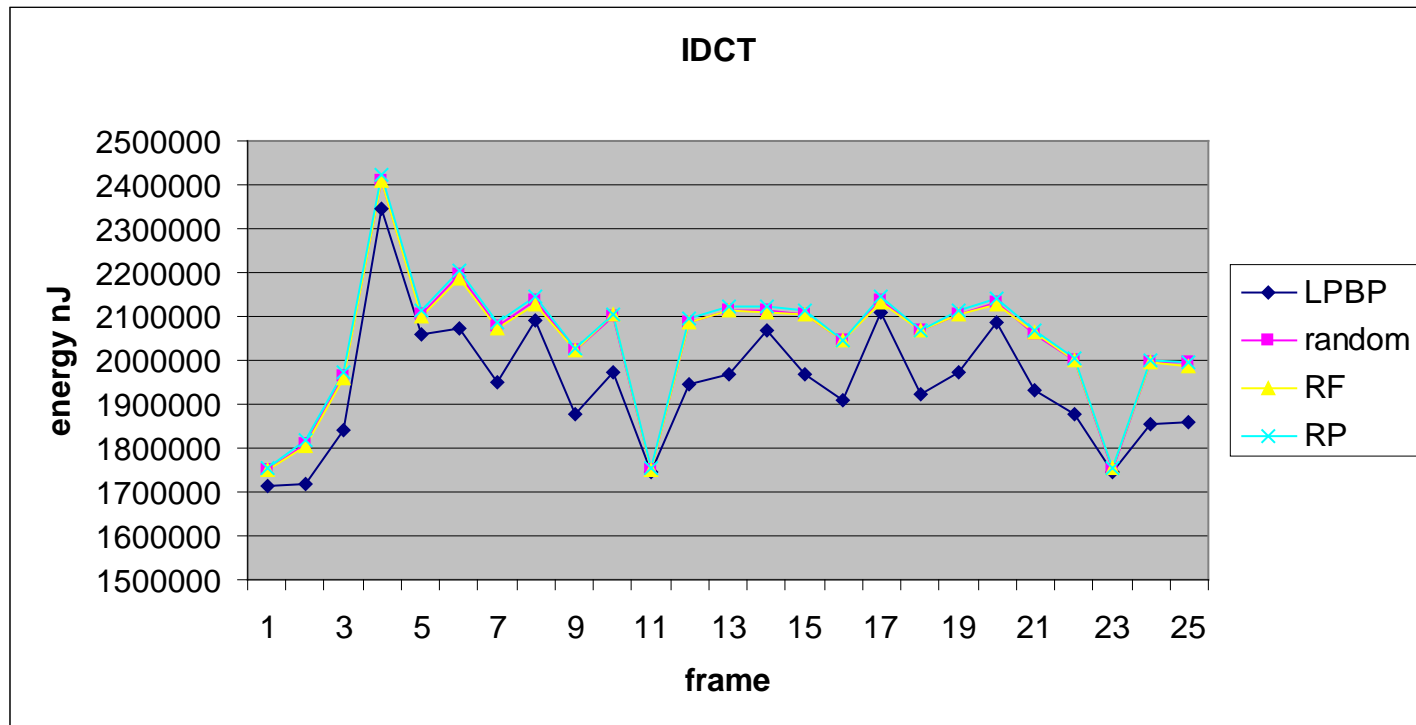
# xSTream simulator + plug-in (from WP5)

- For each **xPE** a device monitors spent cycles and energy consumption using current values of powers and clock frequency that are set with the configuration file.
  - To be used at SW level, *cycles* and *energy* are written onto registers



# Experimental results

- For a mpeg2 decoding on a 25-frame/sec video with resolution 720x576, LP+BP always meets the frame deadline of 0.04sec saving up to 6% of energy per second



# Variable Platforms

- fVAR: degraded platform with maximum spread in frequency

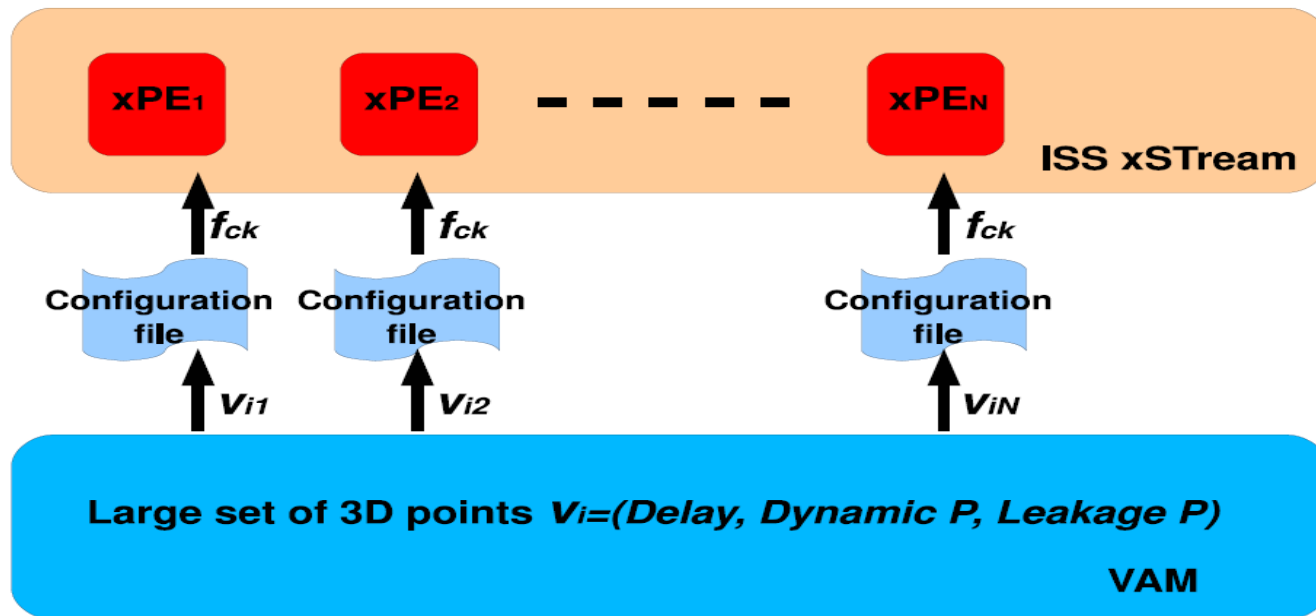
	FCK		PdynA	PlkgA	PdynS	PlkgS	PdynI	PlkgI
xpe1	1.00		0.77	0.45	0.52	0.43	0.00E+00	7.98E-05
xpe2	0.81		0.85	0.50	0.57	0.48	0.00E+00	7.98E-05
xpe3	1.00		1.02	0.49	0.69	0.47	0.00E+00	7.98E-05
xpe4	0.84		0.87	0.50	0.59	0.48	0.00E+00	7.98E-05
xpe5	1.00		0.99	0.49	0.67	0.47	0.00E+00	7.98E-05
xpe6	0.84		0.83	0.49	0.57	0.47	0.00E+00	7.98E-05
xpe7	1.00		0.99	0.49	0.68	0.47	0.00E+00	7.98E-05
xpe8	0.84		0.80	0.48	0.54	0.46	0.00E+00	7.98E-05

- pVAR: degraded platform with maximum spread in power

	FCK		PdynA	PlkgA	PdynS	PlkgS	PdynI	PlkgI
xpe1	0.88		0.71	0.46	0.48	0.44	0.00E+00	7.98E-05
xpe2	1.00		1.03	0.50	0.70	0.48	0.00E+00	7.98E-05
xpe3	1.00		0.77	0.45	0.52	0.43	0.00E+00	7.98E-05
xpe4	1.00		1.04	0.50	0.71	0.48	0.00E+00	7.98E-05
xpe5	0.84		0.80	0.48	0.54	0.46	0.00E+00	7.98E-05
xpe6	1.00		1.04	0.50	0.71	0.48	0.00E+00	7.98E-05
xpe7	0.84		0.81	0.48	0.55	0.46	0.00E+00	7.98E-05
xpe8	1.00		1.05	0.50	0.71	0.48	0.00E+00	7.98E-05

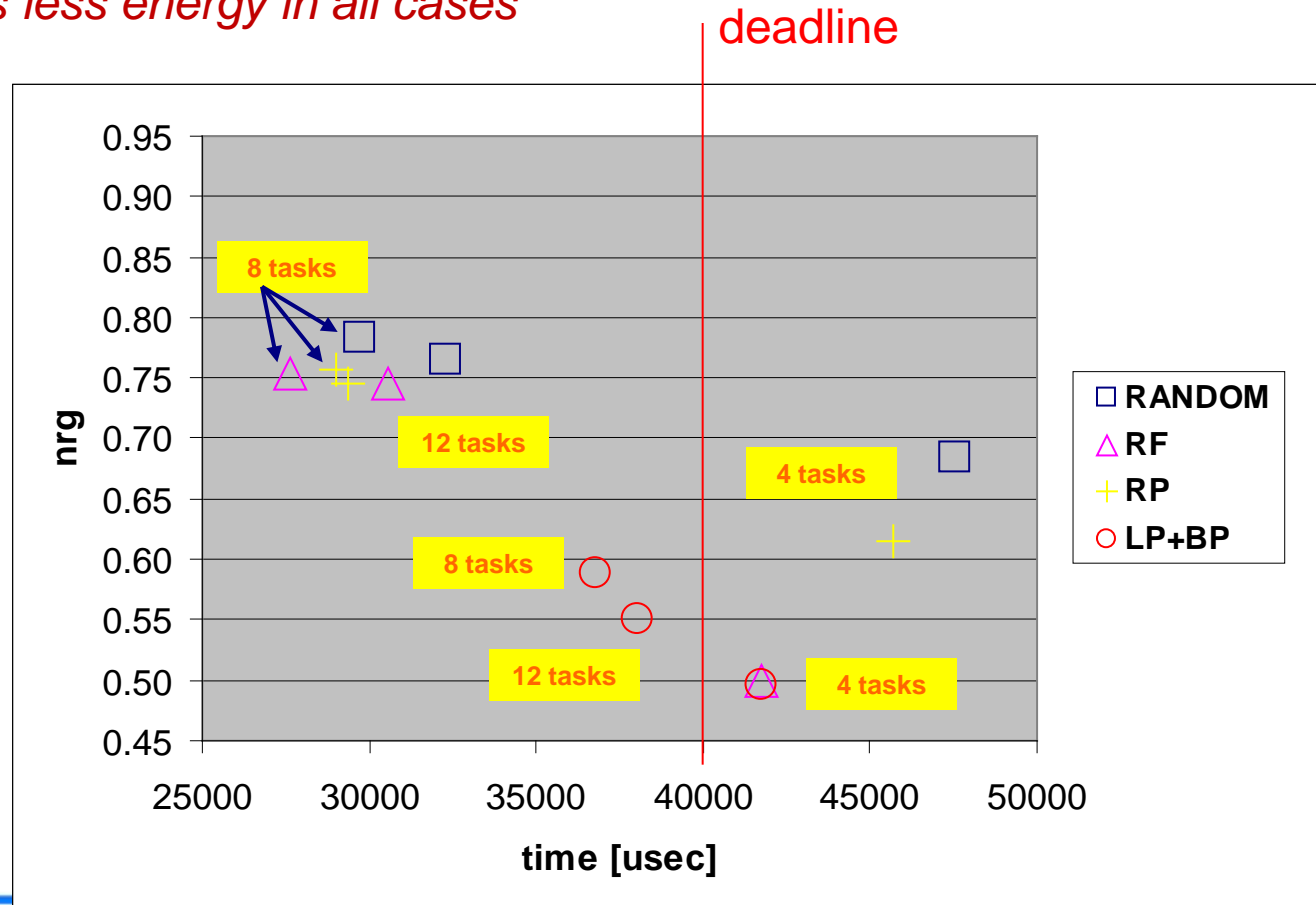
# Variability Injection

- VAM extracts a set of values for longest path delay, dynamic power, and leakage power.
- ISS plug-in set clock frequency in according to longest path delay, and stores power values to be evaluated the energy consumption during a run.



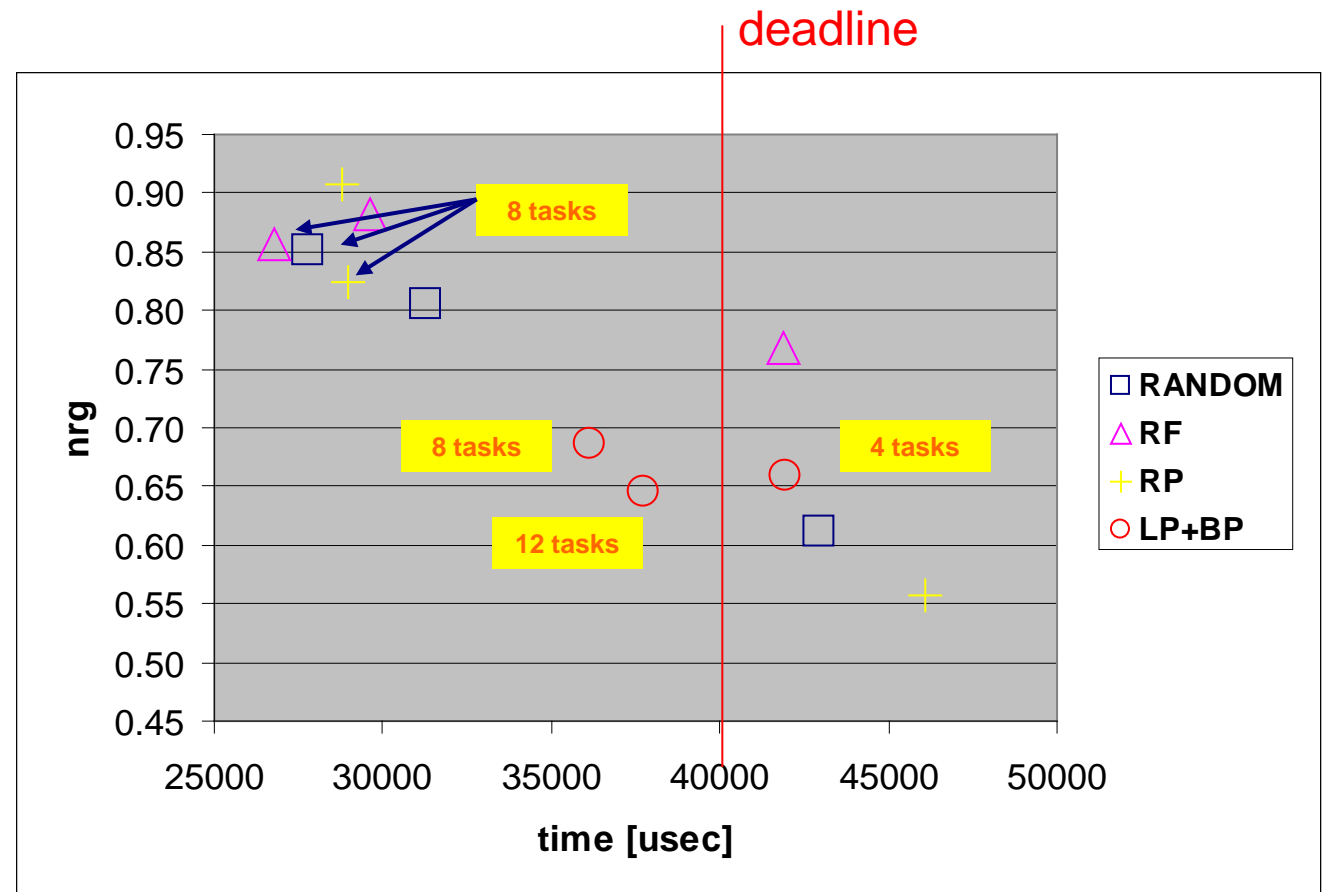
# fVAR Platform Results

- For 4 tasks they are too much large to meet the deadline for all frames, LP+BP and Rank Frequency have the minimum time violation.
- *LP+BP consumes less energy in all cases*



# pVAR Platform Results

- Also in this case the VA policies are located in the lower side of the plot



# LP+BP execution time

LP+BP can be applied online

execution time [musec]	3slaves	6slaves	9slaves	12slaves	16slaves
LP	202	402	617	851	1189
BP (8 tasks)	6	21	64	109	168
BP (16 tasks)	13	37	64	112	159
BP (32 tasks)	36	86	153	240	421

- execution on the ST231 processor of the xStream platform running at 600 MHz
- For MPEG2 decoder we have maximum 12000 musec to find the allocation